DISSERTATION ON COMPARISON BETWEEN ULTRASOUND GUIDED AND BRINKMAN`S APPROACH FOR INTERNAL JUGULAR VEIN CANNULATION

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CERTIFICATE

This is to certify that this dissertation entitled dissertation on comparison between ultrasound and Brinkman's approach to internal jugular vein cannulation is the bonafide original work of Dr.K.VINOD, in partial fulfillment of the requirement for MD anaesthesiology examination of the Tamilnadu Dr. MGR Medical University to be held in March 2009.

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DECLARATION

I, Dr.K.VINOD, solemnly declare that dissertation titled, Dissertation on comparison between ultrasound guided and Brink's approach to internal jugular vein cannulation is the bonafide work done by me at Govt. .Stanley medical college and hospital during the period August 2007 to August 2008 under the expert guidance and supervision of Prof. Dr. P. Chandrasekar M.D. D.A.

The dissertation is submitted to the Tamilnadu Dr. MGR Medical university towards partial fulfillment of requirement for the award of MD Degree in anaesthesiology.

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CONTENTS

INTRODUCTION

Catheterisation of IJV is commonly performed to obtain central venous access for hemodynamic monitoring, long term fluid administration, administering antibiotics, total parenteral nutrition and hemodialysis. The successful puncture of IJV is routinely achieved by using anatomical landmark on the skin surface and then passing the needle along the anticipated course of vein.

Many landmark guided technique are described since 1966. Complications including death are influenced by patient factors such as BMI, site used for cannulation and operator experience. Several studies have shown that USG guidance is beneficial in placing central venous catheters by improving the success rate, reducing the number of needle punctures and by decreasing complications.

Also employment of ultrasound imaging may identify patients in whom consequence of complication could be more serious. Although USG method has been compared favourably with landmark technique its widespread use is hampered by the unavailability of equipment and lack of trained personnel. As it is one of the emerging technologies in our set

up this study therefore was designed to compare the ultrasound guided approach with landmark guided approach of IJV cannulation.

AIMS AND OBJECTIVES

To compare the technique of ultrasound guided central venous cannulation with anatomical land mark guided [Brinkman`s approach][1] central venous cannulation by analysing

1) Access time
2) Number of attempts
3) Mechanical complications
4) Success rate

REVIEW OF LITERATURE

ANATOMY

- The neck comprises of

1) Anterior triangle

   Carotid triangle

   Sub mandibular triangle

   Sub mental triangle

   Muscular triangle

2) Posterior triangle.

- Internal jugular vein leaves the skull through jugular foramen with Glossopharyngeal, Vagus and Accessory nerve.

- In the surface this point corresponds to inter tragic notch, inferior to tragus and antitragus.

- IJV traverses through carotid triangle before running deep to sternocleidomastoid about half way down the anterior border.
- At sterno clavicular joint the IJV passes between the sternal and clavicular head . Inferior to this it joins sub clavian vein and continues as brachiocephalic vein.
- The left brachiocephalic vein runs deep to manubrium sterni and joins right brachio cephalic vein and forms superior venacava before entering right atrium.
- In the neck IJV is accompanied by carotids and vagus, enclosed in carotid fascia – which is condensation of deep fascia.
- The common carotd divides into the internal and external carotid arteries at the upper border of thyroid cartilage.
- Carotid artery lies medial to IJV and vagus lies posteromedially between two structures.
- Ansacervicalis C1C2C3 travel on anterior aspect of carotid sheath to supply infrahyoid muscles of the neck.

- The accessory nerve travels with the carotid artery outside carotid sheath and passes to sternocliedomastoid[4].

HISTORY

- The first recorded placement of central venous cannula in a human occurred in 1929, at the August Victoria home at Eberswalde near Berlin, when Werner forssman cannulated himself by passing a catheter from his own left cephalic vein into his right atrium[3].

- Aubainac -1950 – cannulated subclavian vein for the first time.

- Seldinger first described his guide wire technique for central vein cannulation in 1956.

- Though there are numerous approaches of IJV cannulation they are broadly classified as

1) High approach –site of cannulation is at the point at the apex of the triangle formed by the two heads of sternomastoid or above.

2) Low approach –site of cannulation is below the apex

HIGH APPROACHES

- Boulanger et al[5]. 1976 high technique – Medial approach. Point of insertion of needle is at the superior border of the thyroid cartilage on the medial border of the sternomastoid muscle .Direct the needle just underneath the sternomastoid, keeping close to its posterior aspect.

- Mostert et al.[6]. 1970. High technique: Medial approach. Point of insertion of needle is along the medial border of sternomastoid muscle at its midpoint just lateral to the carotid artery. This is above the level of the cricoid cartilage.

- Vaughan and Weygand[7]. 1973. High technique : Central approach. Point of insertion of needle at apex of the triangle bounded below by the inner edge of the sternal insertion and the outer edge of clavicular insertion and above by the junction of the two heads of the sternomastoid muscle.

- Prince et al.[8]. High technique : Central approach. Point of insertion of needle is the apex of the triangle formed by the two heads of the sternomastoid muscle and the clavicle and the needle is directed towards ipsilateral nipple.

- Civetta et al[9]. 1972. High technique : Central approach. Point of insertion of needle is 5cm above the clavicle and 1cm medial to the lateral border of the sternomastoid muscle.

- Brinkman and Costly[2]. 1973. High technique – Lateral approach. Point of insertion of needle is along the lateral border of sternomastoid muscle cephalad to the junction of the external jugular vein and the muscle. Advance the needle beneath the belly of the muscle, aiming towards the sternal notch.

- Hall and Geefhuysen et al[10]. Alternative method. 1977. High technique: Lateral approach. point of insertion of needle at the mid point of the sternomastoid muscle on its lateral edge and directed towards suprasternal notch.

LOW APPROACHES

- Jernigan et al[11]. 1970. Low technique : Lateral approach. Point of insertion of needle two - finger - breadths above the clavicle on the lateral border of the clavicular head of the sternomastoid muscle .then advance the needle towards the suprasternal notch.

- Daily et al[12]. 1970. Low technique : Central approach. Point of insertion of needle at the centre of the triangle bounded below by the inner of the inner edge of the sternal insertion and above by the junction of the two heads of the sternomastoid muscle and directed caudally.

- Rao et al[13]. Low technique :Central approach. point of insertion of needle is just above the notch on the upper surface of the clavicle.

- English et al[14]. 1969 High technique : Central approach. Point of insertion of needle is cephaled and medial where the vein is most clearly felt.

- English et al[14]. Alternative method 1969. Low technique : Central approach. Point of insertion of needle near the apex of the triangle formed by the sternal and clavicular heads of the sternomastoid muscle and the clavicle. Advance the needle towards the inner border of the anterior end of first rib behind the clavicle

- Hall and Geefhuysen et al[10]. 1977 Low technique : Central approach. Point of insertion of needle is near the triangle formed by the two heads of insertion of the sternomastoid muscle and directed laterally.

INDICATIONS FOR PLACEMENT OF CVC

1) Measurement of central venous pressure

- Major surgery where major blood loss or fluid shifts is anticipated.
- Major trauma.
- Patients with significant cardiac disease.
- Patients with significant pulmonary disease .

- For intra vascular volume assessment in patients when urine output is unavailable or unreliable.

2) Intravenous access

- Rapid infusion or intravenous fluids and blood using large bore cannulae.
- Administration of vasoactive or irritating drugs (concentrated potassium infusions)
- Total parenteral nutrition
- Frequent blood sampling.
- Chronic drug administration.
- Inadequate peripheral venous access.

3) Therapeutic procedures

- Insertion of transvenous pacemaker.
- Insertion of catheters for hemodialysis and plasmapheresis.
- Aspiration of air emboli.
- IJV filter placement.

4) Pulmonary catheterisation and monitering[2].

CONTRAINDICATIONS

- Absolute

1) SVC syndrome where cannulation of IJV, EJV, Antecubital vein and Subclavian vein cannulation has to be avoided

2) Abdominal trauma and IVC disruption where femoral vein cannulation has to be avoided.

3) Infection at site of cannulation.

- Relative

1) Coagulopathy (platelet count < 50,000 cells per cumm, inr >1.5)

2) Newly inserted pacemaker wires

3) Presence of carotid disease (IJV cannulation)

4) Recent cannulation of the IJV

5) Contralateral diaphragmatic dysfunction

6) Thyromegaly or prior neck surgery[2]

COMPLICATIONS

Comman complications

1) Carotid puncture

2) Double wall puncture

3) Haematoma

4) Haemothorax

5) Pneumothorax

Other complications reviewed in literature

1) Endotracheal tube cuff puncture[15]

A Complication which results if needle is directed too far medially.

2) Displacement of catheter with neck flexion[16]

Cervical flexion leads to movement of central venous catheter tip from right atrium to right ventricle.

3) Thoracic duct injury with left chylous hydrothorax[17]

A low approach to the left internal jugular vein damaged the thoracic duct and caused a chylo thorax in which surgical ligation of the duct was required.

4) Inadvertent thoracic duct catheterisation[17]

Routinely right internal jugular vein should be used for cannulation. If left IJV has to be cannulated stiff central venous catheters should be avoided.

5) Bilateral pneumothorax and sub cutaneous emphysema from a tracheal laceration[18]

21 S.W.G needle used for venipuncture in a neonate . the trachea was probably lacerated causing mediastinal emphysema , rupture of the mediastinal pleura and bilateral pneumothorax.

6) Tension pneumothorax[19]

After pre operative insertion of cannula into right internal jugular vein tension pneumothorax was diagnosed

during operation nitrous oxide administration should be discontinued if this occurs and the pneumothorax should be tapped.

7) Bilateral hydrothorax[20]

Internal jugular vein catheter slipped out of vein and intravenous fluid accumulated in pleural spaces.

8) Bilateral hydrothorax[20]

It is sometimes possible for fluid under pressure in pleural cavity to flow into opposite pleural cavity.

9) Mediastinal fluid extravasation in 2 infants following the use of the infusion pump[21]

Extravasation of fluid into mediastinum reported in two infants associated with use of an infusion pump. Only gravity fed devices for delivering fluid should be used infants and neonates.

10) Fatal haemothorax following damage to the ascending cervical artery[22]

Ascending cervical artery damaged prior to cardiac surgery when unsuccessful attempt was made to cannulate right internal jugular vein. Fatal postoperative haemorrhage occurred. Early surgical exploration is mandatory if this complication is suspected.

11) Bilateral vocal cord paralysis[23]

Occurred after bilateral attempts at internal jugular vein cannulation. Cervical haematomas caused temporary dysfunction of recurrent laryngeal and nerves tracheostomy was required.

12) Extensive neurological damage[24]

Lesions of left 9- 12 cranial nerves, anterior primary rami of left

2-4 cervical nerves and left horners syndrome. Caused by pressure from haematoma or by chemical damage from extravasated fluid and drugs it contained (4).

13) Horners syndrome[24]

Resulted from damage to cervical sympathetic trunk lying behind carotid artery but outside carotid sheath either by needle or from a haematoma

14) Air embolus after accidental removal of catheter with canulla left in vein

Cardiac arrest secondary to air embolus. patient suffered cerebral damage and failed to regain consciousness. Introducing cannula should be removed from vein after the catheter has been inserted and the catheter should be securely stitched in place.

15) Postoperative cervical haematoma requiring surgical evacuation[25]

Occurred after unsuccessful attempt at internal jugular vein cannulation in patient who underwent coronary artery surgery. Haematoma was removed 6weeks postoperatively.

16) Respiratory obstruction due to cervical haematoma[26]

Large cervical haematoma followed venous cannulation in patients with coagulation defects . In such

patients use of arm veins for central venous cannulation is indicated.

17) Superior vena cava thrombosis[27]

Developed 5 days after venous cannulation in a 72 year old woman. thrombectomy undertaken using cardiopulmonary bypass.

18) superior vena cava syndrome[27]

Catheter passed through narrowed segment of SVC and symptoms of obstruction developed. These resolved on removal of catheter.

19) Aortic catheterisation[28]

Occurred in child with transposition of great arteries with use of low approach to veins on right side.

20) Aortic dissection[29]

Followed a number of attempts at venous catheterisation when using 7 cm needle and catheter.

21) Pseudoaneurysm of the brachiocephalic arteries[21]

Three cases of cervical arterial aneurysm due to arterial laceration following low lateral approach of vein. Pseudoaneurysm were treated surgically.

22) Cardiac arrest[30]

Compression of carotid artery following accidental arterial puncture resulted in cardiac arrest .ECG monitering is recommended during cannulation for early diagnosis

23) Ventricular fibrillation[31]

Ventricular fibrillation during carotid artey palpation prior to internal jugular vein cannulation . Care during arterial palpation advocated.

24) Cardiac tamponade[32]

Can be caused by central venous catheter, introduced through any route. If its tip lies below the line of pericardial reflection and it perforaters the vascular wall. However, this is least likely to arise with the IJV route probably because the catheter tip lies clear of vessel wall[20].

25) Bacteremia[2]

Incidence -7.7per 1000 patients in icu

11.3 per 1000 patients in non icu setup

Incidence of bacteremia is of the following order

Femoral vein > IJV > subclavian vein

Multilumen catheter > single lumen catheter

Non cuffed > cuffed catheter

The most comman organisms implicated are

1. 37% Coagulase negative staphylococcus
2. 25% Gram negative organisms
3. 10% Enterococci
4. 9% Candida

Flush solution containing vancomycin and ciprofloxacin with heparin decreases blood stream infection but did not increase the prevalence of resistant organism.

Chlorhexidine and silver sulpha diazine reduced catheter colonization by 44% and Blood stream infection by 79%.

CENTRAL VENOUS PRESSURE AND WAVE FORM

Central venous pressure is determined by the interaction of two function.

1. Cardiac function which represents the classic starling length tension relationship.

2. Venous return function which defines the return of blood from the vascular reservoir to the heart.

- A wave –Atrial systole.
- C wave – Bulging tricuspid valve due to right ventricular contraction.
- X wave – Atrial relaxation.
- V wave – Passive venous filling.
- Y wave – Opening of tricuspid valve.

1. Atrial fibrillation – no A wave
2. Heart block – cannon waves
3. Nodal rhythm – cannon waves
4. Tricuspid regurgitation- large C and V waves, absent X descent.

5. Tricuspid stenosis –large A wave attenuated Y descent[45]

PRINCIPLES OF MEASUREMENT

An important point that is often not respected is that hydrostatic pressures are relative to an arbitary reference level, and changes in reference level cause a change in the pressure measurement. The effect of leveling on the measurement of CVP is particularly important because small changes in central venous pressure have large hemodynamic effects. The commonly accepted reference level for vascular measurements is the mid point of the right atrium this can be identified on physical examination at a vertical distance 5 cm below the sternal angle, which is where the second rib meets the sternum. This is true whether the subject is supine or sitting up at a sixty degree angle because the right atrium is anterior in the chest and the atrium has a relatively round shape.

Thus a 5 cm vertical line from the sternal angle remains in the approximate centre of the atrium even when the person is sitting upright at a sixty degree angle this means that patient do not have to be supine for measurements when this reference level is used.

More commonly, mid thoracic position at the level of the fifth rib is used in intensive care units. The greater simplicity of the mid thoracic

position also likely results in less rigor in proper leveling. Values measured relative to the mid thoracic reference level are on average 3 mm hg greater than those based on the reference level 5 cm below the sternal angle.

Another important consideration for the measurement of central venous pressure is when to make the measurement in relation to the normal A, C and V waves. The A and V waves can often be in the range of 8- 10 mm hg, which means that there is a large difference in the value at that of middle or bottom.

The pressure at the base of the C wave is most appropriate because this is the last atrial pressure before the ventricular contraction and hence the best estimate of cardiac preload. If the C wave cannot be identified, the base of the A wave gives a good approximation.

Alternatively, if the moniter has the capacity of recording ECG Simultaneously a vertical line drawn through the Q wave of the ECG will help identify the C wave. On the other hand, if there is a tall A or V the peak of these waves still has hemodynamic consequences for upstream organs such as the liver and the kidney. Further more the CVP in most dependent parts of the body in the supine position is 8 – 10 mm

hg higher than that measured on the basis of 5 cm below the sternal angle measurement. This is the pressure that drives the local capillary filtration[16].

RISK FACTORS PREDICTING DIFFICULTY IN OBTAINING CENTRAL VENOUS ACCESS

1. Atypical anatomy.
2. Post radiation therapy.
3. Clavicular injury.
4. Previous sternotmy.
5. Coagulopathy.
6. Venous thrombosis at site of insertion.
7. Restless patient.
8. Morbidly obese.
9. Infant and children.
10. Lack of experience.
11. Scarred vessel.

12. Previous central venous catheter insertion at the same site[2].

CHOICE OF CATHETER

1. Non tunneled
2. Tunneled
3. Implanted ports
4. Apheresis / dialysis catheter
5. Peripherally inserted central catheter

The above mentioned catheters can be single or multilumen and open end or valved.

NONTUNNELED CATHETERS

- Used for short period (< 10 days)

ADVANTAGE

- Ease of insertion
- Less expensive

DISVANTAGE

- The risk of BSI and catheter colonization is high. Now a days antimicrobial coated and antiseptic coated catheters are available

TUNNELLED CATHETERS

- Indicated in patients requiring long term usage [more than 30 days]

ADVANTAGE

- Reduced incidence of infection
- The anchoring cuff within subcutaneous tissue creates an inflammatory reaction leading to fibrosis with catheter fixation. This usually occurs within 3 – 4 weeks of insertion.
- Presence of valves ensures that no flush is required but fluid has to be infused at high pressure.

DISADVANTAGE

- Expensive

IMPLANTED PORTS

ADVANTAGE

- Least incidence of BSI
- Long term usage - in patients with sickle cell disease where repeated transfusion is required.
- Less restriction of physical activity.

DISADVANTAGE

- Costly to purchase and operate
- It leaves large scar

APHERESIS OR DIALYSIS CATHETER

- Tunneled or non tunneled

ADVANTAGE

- Long term use
- Large bore catheter

DISADVANTAGE

- Strong heparin flush (5000 IU units per ml) is required and the flush solution volume should be equal to catheter size inorder to avoid systemic heparinisarion.

PERIPHERALY INSERTED CENTRAL CATHETER

- Used with great success in neonatal ICU
- Although the lines are placed peripherally their tip lies in the central veins.
- Used when intermediate term IV access for prolonged home or hospital therapy such as those with HIV infections, cystic fibrosis, osteomyelitis, cancer and meningitis
- Success of introducing PICC line is greater if attempts at inserting peripheral lines is limited.

ADVANTAGE

In the event of coagulopathy this approach is the safest[33].

OTHER SITES OF CENTRAL VENOUS ACCESS

EXTERNAL JUGULAR VEIN

External jugular vein is another means of reaching the central circulation, the success rate with this approach is lower because of the tortuous path followed by the vein. A valve is usually present at the point where the External jugular vein perforates the fascia to join with the subclavian vein. One study however reported a success rate of 90% using a J – wire to manipulate past obstruction into the central circulation the main advantage of this technique is that there is no need to advance the needle into the deeper structures of the neck.

For this approach the patient is placed supine or in the Trendelenburg position until the External jugular vein becomes distended. The vein is then cannulated with an intravenous catheter. A guide wire with curved tip is passed through the cannula and manipulated into the central circulation. The curved tip is necessary to negotiate the tortuous course between the external jugular vein and superior venacava. Mannipulation of the shoulder and rotation of the guide wire between the operators fingers may be useful maneuver's when difficulty is encountered in passing the wire into the superior venacava[34].

SUB CLAVIAN VEIN

The sub clavin vein is ready accessible from supra clavicular or infraclavicular approaches and has long been used for central venous access. The success rate is higher than the EJV approach but lower than the IJV approach, especially pneumothorax. Other complications associated with sub clavian vein cannulation are arterial injury, cardiac tamponade, mediastinal hematoma and hemothorax.

This may be the cannulation site of choice, however when CVP monitering is indicated in patients undergoing carotid artery surgery. It is also useful for parenteral nutrition or for prolonged CVP access because the site is easier to maintain and well tolerated by patients.

The infra clavicular approach is performed with the patient supine or in Trendelenburg position with a folded sheet between the scapula and the shoulder lowered. The head is turned to contralateral side. A thin walled needle is inserted 1 cm below the midpoint of the clavicle and advanced towards the suprasternal notch under the posterior surface of the clavicle when a free flow of venous blood is obtained the guide wire is passed into the subclavian vessel and is exchange for a CVP catheter.

The supraclavicular approach is performed with the patient in the Trendelenburg position with the head turned away from the side of the insertion. This is usually not performed on the left side because of the risk of an injury to the thoracic duct. The finder needle is inserted at the lateral border of sternomastoid at the point of insertion into the clavicle. The needle is directed to bisect the angle between the sternomastoid and the clavicle, and about 15-20 degrees posteriorly. The venel is very superficial and lies very close to the innominate artery and the pleura[35].

ANTECUBITAL VEINS

Another route for central venous monitering is through the basilic or cephalic veins. The advantages of this approach are the low likelihood of complications and the ease of acces intraoperatively, if the arm is exposed. The major disadvantage is that it is often difficult to assure placement of the catheter in a central vein studies have indicated that blind advancement will result in central venous cannulation in 59% to 75% of attempts chest radiographs are usually necessary to confirm that the tip of the catheter has been appropriately placed, and this involves some time delay[36].

Exact positioning of the catheter tip is crucial because movement of the arm will result in significant catheter migration and could cause cardiac tamponade. Unsuccessful attempts results most frequently from failure to pass the catheter past the shoulder, or cannulation of the ipsilateral IJV. Turning the head of the ipsilateral side may help prevent IJV placement of the cather.

Artru et al[37]. reported a high success rate (92%) for the placement of multiorifaced catheter from the antecubital vein using intravascular electro cardiography. These catheters are positioned at the SVC – RA junction and are used for the aspiration of air emobl in neurosurgical patients. Due to problems inherent with intravascular electro cardiography, TEE is used to assess correct placement of catheter.

FEMORAL VEIN

The femoral vein is rarely cannulated in the adult patient for intraoperative monitoring purposes. However, cannulation of this vein is technically simple, and the success rate is high. Cannulation of the vessel should be done about 1-2 cm below the inguinal ligament.

Although older literature reported a high rate of catheter sepsis and thrombophlebitis with this approach, this may no longer be valid with disposable kits subcutaneous tunneling reduces incidence of infection.

Indicated is SVC obstruction catheter should be long enough so that the tip lies within the mediastinal portion of the inferior venacava[38].

ULTRASOUND

Sound is a form of energy resulting from the transmission of mechanical vibrations through a medium. Ultrasound is a sound having frequencies greater than 29kHz, which cannot be detected by human ear. Audible sound has a frequencies ranging from 15 Hz to 20,000 Hz. ultrasound always needs a medium for propagation. It is transmitted through tissues as longitudional waves of alternating compression and rarefaction. The wavelength, frequency, and velocity depends on the nature of the medium and is independent of frequency. It travels faster in solids and slower in gases the average speed of ultrasound in soft tissues is 1540m/s.

Ultrasound beam intensity is a measure of energy associated with the beam and is propotional to square of amplitude. It is expressed in milliwatts/unit area. The relative sound intensities measured on a logarithmic scale and may be expressed in decibels.

PRODUCTION OF ULTRA SOUND

A typical source of ultra sound is a transducer which works on the principle of piezoelectric effect. Transducer is a device that converts electrical energy into ultrasound energy.

The components of transducer include piezoelectric crystal, backing block, insulating cover, matching layer, electrodes and transducer housing. The piezoelectric crystal is mainly made of quartz crystal or asynthetic ceramic such as lead zircoate – titanate.

PIEZOELECTRIC EFFECT

When a crystal is subjected to a given pressure, it develops a voltage across its given surface. Similarly if a voltage is applied across the crystal, a pressure wave is generated in the opposite surface. Thus the crystal converts into electrical energy into ultrasound energy and vice versa. Transducer can transmit and receive ultrasound.

Resonant frequency is the natural frequency of oscilation. It depends on thickness and acoustic velocity of the crystal. Crystals are manufactured so that their thickness is one half of the wavelength .High frequency transducer is thin low frequency transducer is thicker.

The Q factor is related to frequency response of the crystal It determines the purity of sound and the length of time persists. Q factor is determined by the ratio of operating frequency to the band width at full width half maximum.

Most transducers are designed to have short pulses with low Q values. Diagnostic ultrasound uses transducers with frequencies from 1- 20 MHz. A transducer emits 1us pulse of ultrasound, every millisecond and this is reflected back to the transducer from the tissue interface[22].

INTERACTIONS OF ULTRASOUND WITH MATTER

When the transducer is placed in contact with the patient, the particles of the organ begins to vibrate backwards and forwards about their mean position. These particles exert a force on their neighbouring particles so that they also begin to vibrate. Thus energy is quickly transmitted from one point to another in the body. The ultra sound waves may be reflected, refracted ,scattered or absorbed.

ACOUSTIC IMPEDANCE

When ultrasound strikes the boundary between two tissues, some of the sound will be transmitted and some will be reflected back. The

fraction of energy reflected depends on the difference in acoustic impedance of the tissues on either side of the boundary. The impedance is the product density of tissue and velocity of ultrasound in tissue. The acoustic impedance is independent of frequency .The bone- soft tissue interface has large difference in impedance as compared to that of fat – muscle. An air –tissue interface reflects all the energy back due to large difference in impedance. It is for this reason that the transducer must make good contact with the patient skin, by using a gel.

REFLECTION

The portion of ultrasound beam that is reflected at tissue interfaces is echoed and is used to generate ultrasound image. The percent of reflected ultra sound depends on the angle of the incidence of the beam and the acoustic impedance of the tissues.

At a musle – air interface, almost 100% of ultrasound is reflected hence the anatomy beyond the air filled cavities cannot be imaged. Organs such as kidney, pancreas, spleen and liver contain scattering sites, give rise to a speckled texture. While organs like bladder, cysts and blood vessels have no internal structure and gives no echoes.

REFRACTION

Refraction is the change in direction of an ultrasound beam when passing from one medium to another that occurs at a boundary interface. In that case frequency remains the same but the wavelength undergoes changes. As the velocity is reduced, the wavelength decreases. Refraction obeys Snells law similar to light.

ATTENUATION

When ultrasound passes through the tissues it gets attenuated due to absorption, and scatterring of the beam. The attenuation of ultrasound varies from tissue to tissue and increases with frequency. The attenuation of ultrasound is homogeneous tissue is exponential. The absorbed ultrasound energy is converted to heat.

CHARACTERISTICS OF ULTRASOUND

When ultrasound beam propagates in the medium two separate regions characterize the travel of the ultrasound energy. It is largely determined by the distance from the transducer . The near field is known as FRESNEL ZONE, is adjacent to the transducer. The far field is known as FRAUNHOFER ZONE, is a conical shaped ultrasound beam of

diminishing energy the beam intensity falls off in both zones due to attenuation and in far zone because of beam divergence. Normally Freznel zone is used for imaging because the resolution is poor in the fraunhofer zone.

Side lobes are unwanted emission of ultrasound energy that is detected towards the side of main pulse. Sidelobes may cause image artifacts. Hence transducers are designed in such a way so as to reduce sidelobe emission.

IMAGE DISPLAY

The returning echoes provide information about the depth of interface and differences between the two echoes are converted back into electrical signals, by using the same or another transducer. Voltage signals are fed to a computer which create an ultrasound image. The image is normally displayed on a television moniter and stored n a computer. The ultrasound images have 512 matrix size, with each pixel being 8 bits deep 256 grey levels are used for image display.

IMAGING MODES

The ultrasound imaging can be done in the following modes namely A - mode ,M –mode and B-mode.

A-mode. - In the A- mode a stationary transducer is pointed in the direction of interest echoes are received from interfaces. As a result transducer crystal produces a voltage that is proportional to the echo intensity. These are displayed on a CRO tube as a graph of amplitude versus time. It displays depth on the horizontal axis and echo intensity on the vertical axis. This not a popular mode ,but suitable for examining midline of brain and bulb of eye.

M-mode. Converts the variation in signal amplitude of A-mode line into a series of dots along display oscilloscope and reflects continuous motion. It is mainly used for analysis of valve leaflet motion.

B-mode made the ultrasound as the diagnostic tool especially in abdominal disease. It provides a picture of a slice of tissue. Thus a tomographic slice is created , with a acoustic tissue characteristics of the body.

DOPPLER ULTRASOUND

The Doppler effect refers to the change in frequency that results from a moving sample or ultrasound source. Movement of object in ultrasound beam changes the frequency of the reflected echo and change in frequency is called Doppler shift.

Objects moving towards the detector appear to have a high frequency and a longer wavelength. The objects moving away from the detector appear to have a lower frequency and long wavelength. If the object is moving perpendicular to the ultrasound beam there is no change in frequency. Doppler ultrasound is useful to investigate variation of blood flow in arteries and veins.

CONTINOUS DOPPLER

It is a simple and least expensive device for measuring blood velocity. This needs two transducers, one with transmitting the ultra sound continuously and the other detecting the resultant continuous echoes. These system suffer from depth resolution and provides little spatial information. It is good for measuring fast flow and deep lying vessels.

PULSED DOPPLER

Pulsed Doppler provides both velocity and depth information simultaneously. It combines continuous doppler system to determine velocity and pulse echo system the to determine depth. The system receive the signals that are originating from a specific tissue depth. All other echoes are rejected. The operator can vary the gate position to select Doppler signal from any depth along the axis of the transducer.

Duplex scanning-refers to the combination dynamic B-scan imaging and pulsed Doppler data . In this system the real – time image of the anatomy of interest is obtained first and the image is frozen in the viewing screen. Thus the system allows velocity and position information to be obtained simultaneously.

COLOR DOPPLER

Duplex scanner obtains flow information only – from small areas of the image hence color Doppler has been developed to produce image of flow throughout the image area. It also allows visualization of blood vessels and their flow characteristics plus images of tissue surrounding the vessel. The walls of the blood vessel or heart chamber are studied with this mode.

The major advantages of ultrasound are no harmful bio – effects, non invasive method and relatively cheaper[39].

USG IMAGE OF IJV

Probe orientation – mark on the probe that corresponds to the side of the image on the screen[2].

- Vein appears bigger with a wider lumen and a thinner wall. In hypovolemic conditions vein appears smaller than artery.
- Veins do not pulsate whereas arteries do
- Arteries are not compessible as veins
- IJV appears triangular in cross section whereas arteries appear circular
- IJV becomes wider with head down and valsalva maneuver[2].

MATERIALS AND METHOD

PATIENTS

This is a prospective study conducted from August, 2007 to April, 2008. Fourty patients of ASA physical status 3 and 4 undergoing major gastrointestinal and cardiothoracic surgeries requiring central venous pressure monitoring were included in the study. After obtaining written informed consent the patients were randomly assigned to two groups.

a) Landmark guided group (LMG)

b) Ultrasound guided group (USG)

on a one is to one ratio randomly. The right IJV cannulation was attempted after inducing general anaesthesia in either groups.

LANDMARK GUIDED METHOD

- Patient were put in supine position with a slight head down tilt and face turned towards opposite side.
- The junction of the external jugular vein and sternomastoid muscle was noted. Under strict aseptic precautions the skin was prepared with povidone iodine solution.

- A 22 guage finder needle with a 2cc syringe filled with saline was passed beneath the sternomastoid muscle with the needle directed towards the suprasternal notch.

- Return of venous blood into the syringe by aspiration confirmed entry of needle into the vein.

- The finder needle was used as a guide for a 19 guage 10 cm cannulation needle which was connected to a 5 cc syringe filled with saline.

- Then the vein was cannulated by modified Seldinger`s technique with a 16 cm 7 fr triple lumen catheter[2].

REAL TIME ULTRASOUND GUIDED METHOD

- The neck was painted and draped with patient in supine position as described earlier.

- A standard two dimensional real time B mode imaging obtained with a portable unit and 7.5 MHz linear array ultrasound probe covered with a ultrasound gel and wrapped in a sterile sheath.

- The probe was placed above the junction of EJV and the sternomastoid.
- The depth , caliber of the IJV, patency, compressibility and presence of thrombi were noted.
- In the presence of pre existing thrombi in the vein, opposite side was cannulated.
- The cannulation needle inserted beneath the sternomastoid muscle under US guidance.
- The vein cannulated by modified Seldingers technique with a 16 cm 7 fr triple lumen catheter[2].

Successful placement of the CVC was confirmed later by a chest x-ray after the procedure.

Mechanical complications were defined as

1) Carotid artery puncture - Carotid artery puncture is defined as, forceful pulsatile expulsion of bright red blood from the needle. Arterial puncture was managed by removal of needle and application of firm pressure.

2) Haematoma

3) Haemothorax

4) Pneumomothorax -.. Pneumothorax as evidenced by clinical symptoms and chest x-ray would be treated with tube thoracostomy if it was found to be significant or progressive or if more than 20% interface between lung and the chest wall was separated.

5) Catheter malposition.

6) Double wall puncture – Double wall puncture is detected by appearance of venous blood while with drawing the needle.

All mechanical complications were evaluated clinically by a chest x-ray and ultrasound when appropriate.

DATA COLLECTION AND STATISTICAL ANALYSIS

Forms containing patients characteristics, method of cannulation followed and presence of risk factors for difficult cannulation were noted. The outcomes assessed were

- Access time-time between skin penetration and aspiration of venous blood into syringe. It was measured in seconds .
- Average number of attempts –defined as separate skin punctures.
- Rate of mechanical complication.

In case of multiple attempts access time was calculated as follows the time interval of each attempt that is from skin puncture to withdrawal were added together to derive the fixed access time.

RESULTS

Baseline characteristics in either groups namely the land mark group and ultrasound group were comparable with no significant difference in terms of age, gender ,body mass index, side of cannulation, and risk factors for difficult cannulation.

The results using the land mark technique are in sharp contrast to those obtained by the ultrasound guided technique. The access time and number of attempts were significantly reduced with ultrasound guided technique.

The access time and rate of mechanical complications was higher in landmark guided group of patients a when compared to ultrasound group ($p < 0.05$).

CHARECTERISTICS OF STUDY POPULATION

CHARACTERISTICS	US group	**LM group**
AGE (years)	41.10(+_)13.90	33.35(+_)15.72
GENDER (male/female ratio)	0.75	0.70
BMI	21.51 (+ _)2.45	20.72 (+_)2.27
SIDE OF CANNULATION (right/left)	20/0	20/0
PRIOR CATHERISATION	0	0
RISK FACTORS FOR DIFFICULT CANNULATION	0	0

Age and BMI are expressed as mean (±) standard deviation.

OUTCOME MEASURES IN THE ULTRASOUND GROUP VERSUS THE LANDMARK GROUP OF PATIENTS

OUTCOME MEASURES	**US group**	**LM group**
ACCESS TIME(SECONDS)	9.85(+_)1.98	16.22(+_)2.37
SUCCESS RATE	20 (100%)	18(90%)
CAROTID PUNCTURE	0(0%)	4(20%)
DOUBLE WALL PUNCTURE	1(5%)	3(15%)
HAEMATOMA	0(0%)	2(10%)
HAEMOTHORAX	0(0%)	0(0%)
PNEUMOTHORAX	0(0%)	0(0%)

BMI SCORE

GROUP	MEAN	**SD**	P- Value
US group	21.51	2.45	**0.295**
LM group	20.72	2.27	

P value > 0.05 –not signicant

AGE

GROUP	**MEAN**	**SD**	**P value**
US group	41.10	13.90	0.107
LM group	33.35	15.72	

P value > 0.05 –not signicant

GENDER

GROUP	MALE	**FEMALE**	**ROW TOTAL**	**P value**
US group	15 (75.0)	5 (25.0)	20 50.0	0.723
LM group	14 (70.0)	6 (30.0)	20 50.0	
COLUMN TOTAL	29 72.5	11 27.5	40 100.0	

NOTE –the value within brackets indicate row percentage.

P value > 0.05 –not signicant

ATTEMPTS

GROUP	**1**	**2**	**3**	**ROW TOTAL**	**P value**
US group	19 95.0 63.3	1 5.0 14.3		20 50.0	0.013*
LM group	11 55.5 36.7	6 30.0 85.7	3 15.0 100.0	20 50.0	
COLUMN TOTAL	30 75.0	7 17.5	3 7.5	40 100.0	

P value <0.05

*significant in 5% level

ACCESS TIME

GROUP	MEAN	SD	P value
US group	9.80	1.98	<0.001**
LM group	16.20	2.37	

P value < 0.05

** significant at 1% level

COMPLICATIONS

Group	No Complication	Dwp	Cp	Haem	Row Total	P – Value
US group	19 95.0 63.3	1 5.0 25.0			20 50.0	0.027*
LM group	11 55.0 36.7	3 15.0 75.0	4 20.0 100.0	2 10.0 100	20 50.0	
COLUMN TOTAL	30 75.0	4 10.0	4 10.0	2 5.0	40 100.0	

P value < 0.05

*significant at 1% level

DISCUSSION

Landmark guided techniques has been always associated with variable success rate despite varying incidences of mechanical complications and difficulties. This has been analysed and shown to depend upon two problems

(1) Operators / performers experience

(2) Patient factors

In the study conducted by Dimitrios Karakitsos et al(2) -Access time in land mark guided group was 44.05 seconds compared to 17.1 seconds in ultrasound guided group.

Success rate was 95.25% in landmark guided group compared to 100% ultrasound guided group.

The incidence of mechanical complications was 5-19% in land mark guided technique where as the incidence of mechanical complications were less than 1%.

The average number of attempts was 2.6 in the landmark guided group when compared to 1.1% in the ultrasound group (3).

In the study conducted by Frantz .T. Gibbs et al[41] the incidence of mechanical complications was 5% in the ultrasound guided group whereas the incidence of mechanical complications in landmark guided group was 40%.

National institute of clinical excellence (NICE) recommends that ultrasound guidance is mandatory for all central venous cannulation[44].

In the study conducted by Dr. R.M. Sharma[42] the overall success rate in ultrasound guided group was 98% and complication rate was 2% and the success rate and complication rate in landmark guided technique was similar to that seen in other studies[21].

Real time ultra sound guided central venous cannulation provides the operator with visualisation of the desired vein and surrounding structures prior to and during the insertion of the catheter this method appears to improve the success rate and decrease the complication rate associated with central venous catheter placement.

So the ultrasound guidance, definitely improves accuracy and reduces the complication and access time. The only drawback in it usage is lack of trained personnel and its availability.

CONCLUSION

Ultrasound guided technique for central venous cannulation is the most accurate and safest technique as

a. It improves success rate

b. Reduces complications

c. Reduces access time and number of attempts

d. Helps in identifying thrombi.

ULTRA SOUND GROUP

Sl. No.	NAME	GENDER	AGE	BMI	AT	ATTEMI
1)	Ganapathy	Male	56	24.69	7	1
2)	Kamala	Female	48	25	8	1
3)	Prabavathy	Female	42	22.82	6	1
4)	Kavitha	Female	38	20.82	10	1
5)	Satish	Male	23	20.51	8	1
6)	Sunitha	Female	18	20.83	8	1
7)	Thangamani	Male	38	19.53	9	1
8)	Rajesh	Male	24	23.43	8	1
9)	Sabirabee	Female	56	18.36	11	1
10)	Gopinath	Male	65	22.57	8	1
11)	Murugan	Male	35	21.25	9	1
12)	Krishnan	Male	60	24.22	8	1
13)	Elavarasan	Male	18	18.36	8	1
14)	Muniraj	Male	38	17.30	11	1
15)	Chinaraj	Male	35	20.28	10	1
16)	Rajamanikam	Male	45	18.28	10	1
17)	Kannan	Male	60	24.80	8	1
18)	Sivlingam	Male	40	19.97	12	1
19)	Ramachandran	Male	48	24.15	12	1
20)	Rajendran	Male	35	23.12	25	2

AT-Access TimeIn seconds

BMI - Body Mass Index Kg / m^2

DWP Double wall Puncture

Age in years

ITC –Inability to Cannulate

LAND MARK GROUP

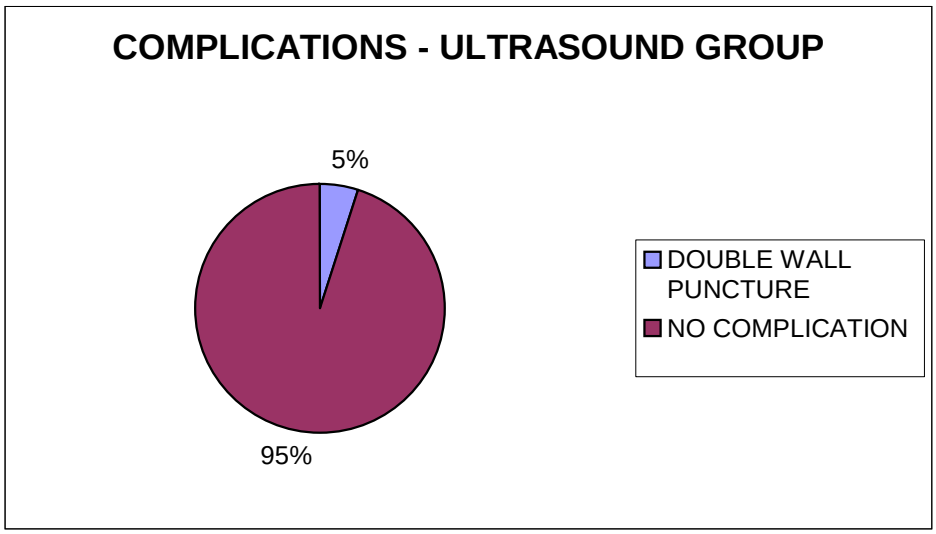
Sl. No.	NAME	AGE	GENDER	BMI	AT	ATTEMPTS	
1)	Venkatesh	40	M	19.53	14	1	
2)	Nagarani	36	F	20.22	18	2	
3)	Syed	20	M	19.55	13	1	
4)	Sulochana	26	F	21.15	12	1	
5)	Anbu	51	M	22.22	21	2	
6)	Selvi	40	F	17.85	14	1	
7)	Mukthiyan	30	M	24.33	22	2	
8)	Keerthana	18	F	21.20	12	1	
9)	Santhosh	18	M	17.85	10	1	
10)	Priyanka	18	F	21.77	10	1	
11)	Gandimathi	35	F	21.20	32	3	
12)	Settu	55	M	21.48	12	1	
13)	Vignesh	18	M	17.77	12	1	
14)	Imran	20	M	22.49	12	1	
15)	Ramesh	25	M	19.38	19	2	
16)	Illayaraja	35	M	20.40	10	1	
17)	Santhana kumar	24	M	18.38	31	3	
18)	Kandasamy	42	M	24.71	10	1	
19)	Boopathy	38	M	24.97	10	1	
20)	Krishnamoorthy	28	M	17.95	30	3	

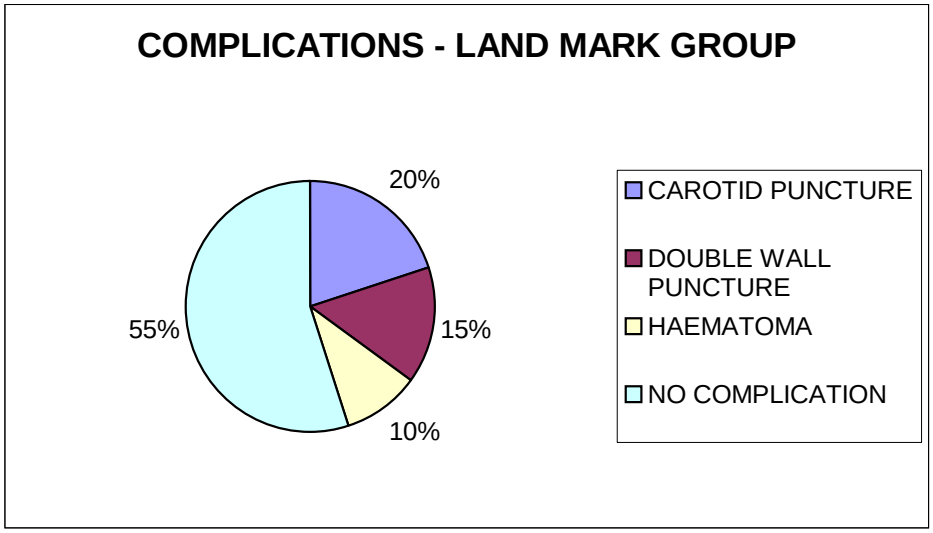
AT - Access time in seconds BMI - Body Mass Index Kg / m^2

ITC - Inability to Cumulate

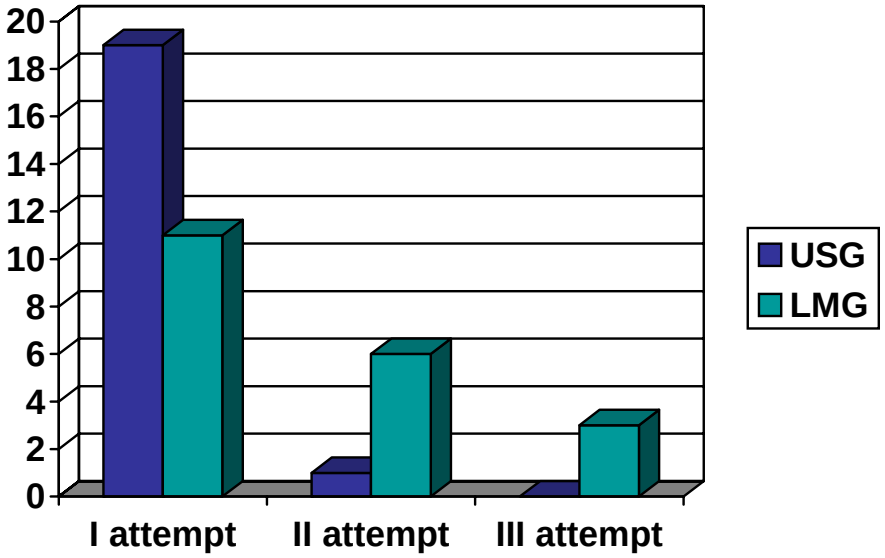
Age in years

DWP - Double Wall Puncture

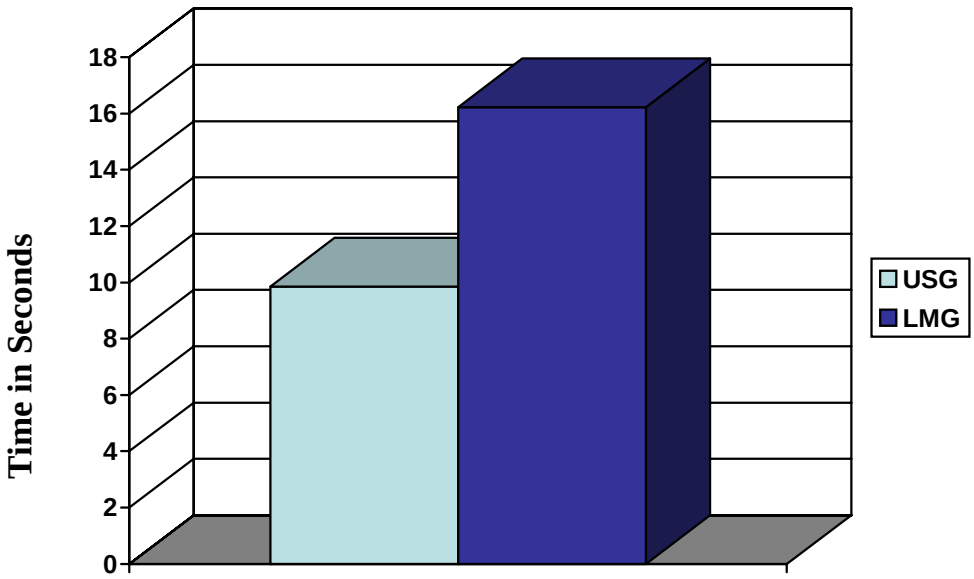

COMPLICATIONS - ULTRASOUND GROUP
5%
95%
DOUBLE WALL PUNCTURE
NO COMPLICATION


COMPLICATIONS - LAND MARK GROUP
20%
15%
10%
55%
CAROTID PUNCTURE
DOUBLE WALL PUNCTURE
HAEMATOMA
NO COMPLICATION

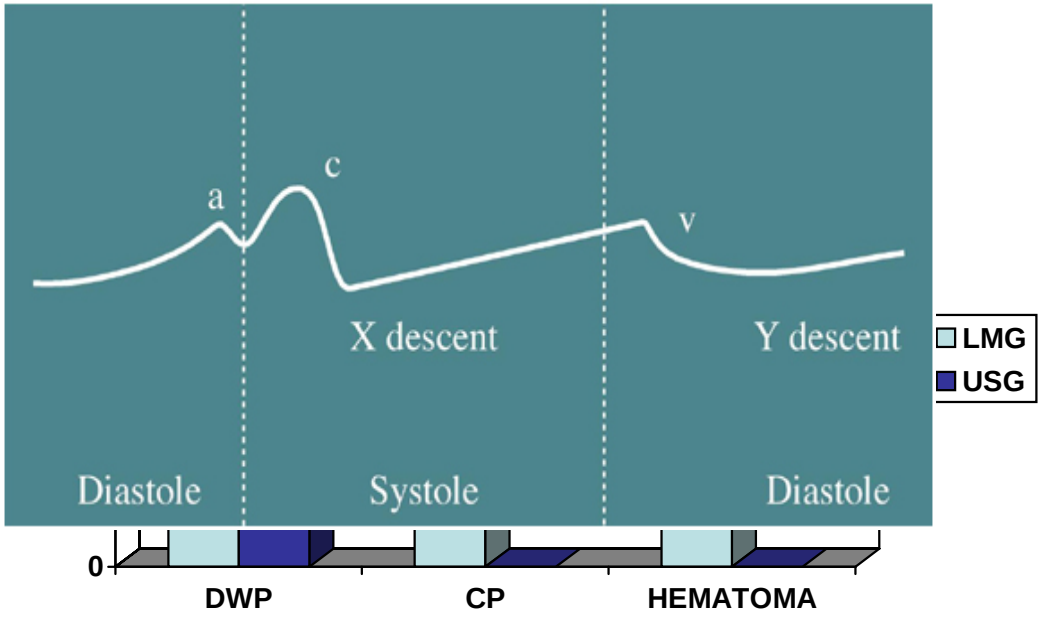
NO. OF ATTEMPTS



ACCESS TIME

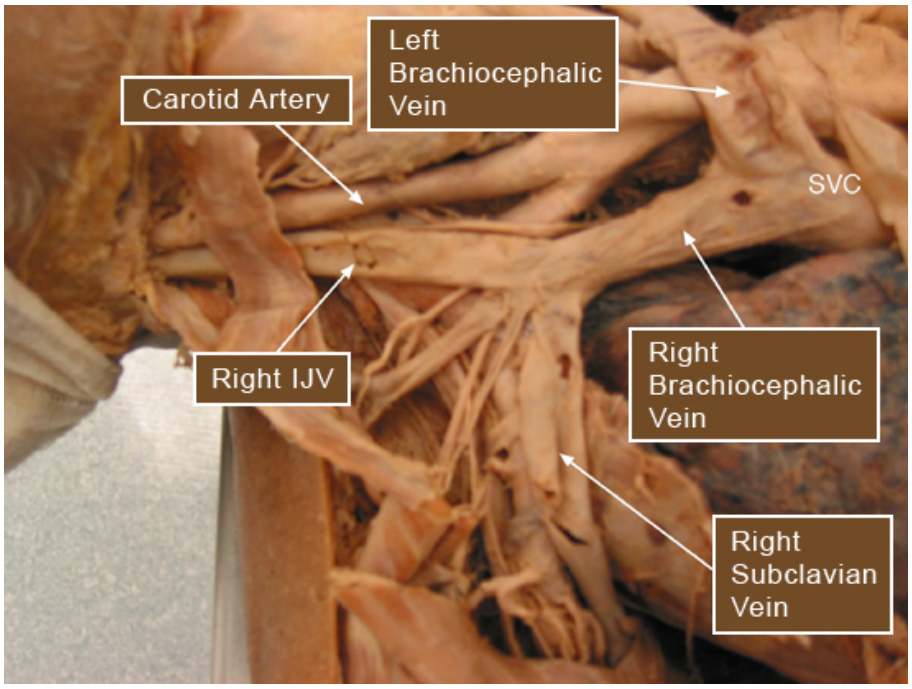


CENTRAL VENOUS PRESSURE WAVE FORM
COMPLICATIONS



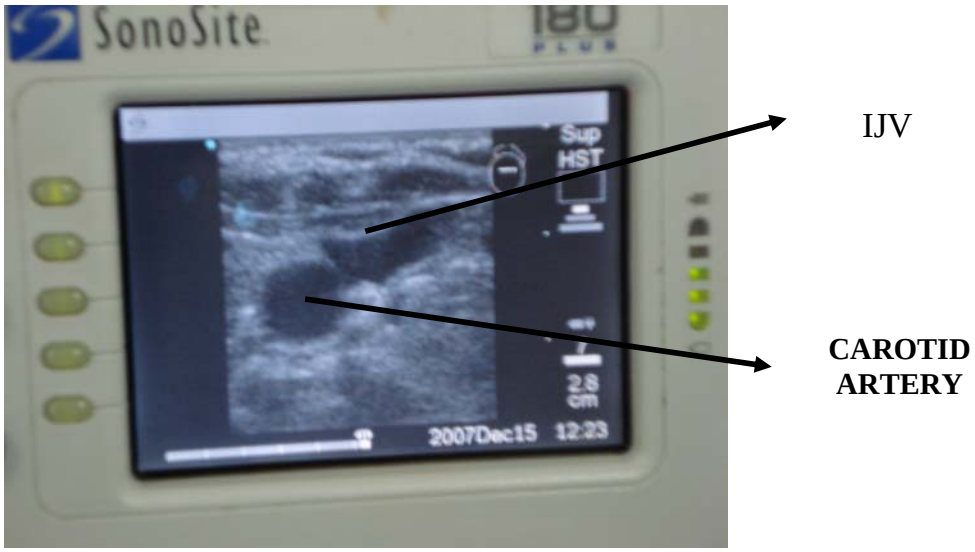
DWP - Double Wall Puncture

ANATOMY OF THE NECK



ULTRA SOUND

RIGHT INTERNAL JUGULAR VEIN

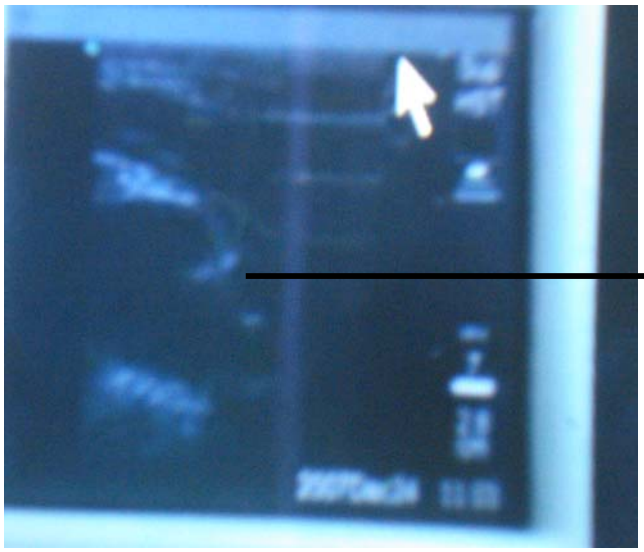


RIGHT INTERNAL JUGULAR VEIN

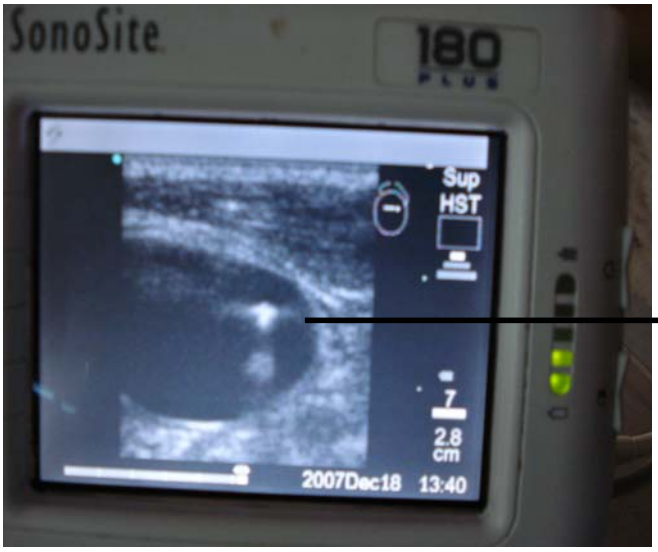
ENLARGEMENT OF THE VEIN DURING VALSALVA MANEUOUR AND HEAD DOWN TILT

PRESENCE OF PROBE COMPRESSION

RIGHT IJV



CANNULATION



CENTRAL VENOUS

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PROFORMA

(1) Name of the Patient :

(2) Age (3) Gender

(4) Height : Weight : BMI:

(5) Date: (6) Physical Status ASA (7) Diagnosis

(8) Surgical Procedure :

(9) Cannulation Done Under (1) G.A (2) LA

(10) Technique Used Cannulation (1) USG (2) Land Mark

(11) Side of Cannulation

(12) Presence of Risk factors for Difficult Cannulation

(13) Difficulties During Previous Cannulation

(14) Known Vascular Anamoly

(15) Untreated Coagulopathy

(16) Skeletal Deformity

(17) Access Time :

(18) Average Number of Attempts

(19) Double Wall Puncture

(20) Arterial Wall Puncture

(21) Hemothorax

(22) Pneumothorax

(23) Hematoma

(24) Tracheal perforation

ABBREVIATIONS

1.	USG	-	Ultra sound group
2.	LMG	-	Land mark group
3.	CVP	-	Central venous pressure
4.	CVC	-	Central venous cannulation
5.	BMI	-	Body mass index
6.	IJV	-	Internal jugular vein
7.	EJV	-	External jugular vein
8.	IVC	-	Inferior vena cava
9.	SVC	-	Superior vena cava
10.	SCV	-	Sub clavian vein
11.	DWP	-	Double wall puncture

Ref.No. /ME1/2007

Stanley Medical College,
Chennai-1 Dt. -9-2007

Sub:Medical Education – Stanley Medical College, Chennai – Ethical Committee constituted for approval of Dissertation/ Thesis submitted – regarding.

The Ethical Committee meeting was held on 3-9-2007 and 7-9-2007 to discuss the paper submitted for Dissertation /Thesis.

The following Members of the Ethical Committee were present and discuss in detail for the approval of the papers presented by the individual by means of power point presentation.

Dr.A.Sundaram, Dean incharge,
Dr.S.Madhavan, Prof. of Pharmacology,
Dr.Thenmozhivalli, Prof. of Microbiology,
Dr.S.Natarajan, Prof. of Medicine,
Dr.K.Balasubramanian, Prof. of Physiology,
Dr.M.L.Shyamala, Prof. of Surgery,
Thiru M.Panneerselvam, Junior Administrative Officer.

LIST OF PAPERS SUBMITTED FOR ETHICAL COMMITTEE APPROVAL
ETHICAL MEETING

Dr. Kiruba Mohan, Prof. of Dermatology

1."N.O.C. for PMS study of pregabalin" - Dr.Parimalam Kumar

2. " A Phase IIb/III trial of LLL-3348 of lupin ltd in plaque psoriasis – Dr.A.Ramesh

Dr.M.Thirunavkarasu, M.D.(Psy)D.PM , Prof. of Psychiatry

"Prevalence, socio-demographic variables and method of suicide among various causes of death."

(2)Psychological autopsy of suicide.

V.Rohit

Effect of chewing gums (XYLITOL)

K.Chinthnidhi

Mycotic infections in immuno compromised and cancer patients.

Malavika Prasad

Profile of Hypertensive emergencies – A study of 100 cases from Dept. of medicine, GSH.

Monalisa Mishra

"Bacterial flora in chronic suppurative otitis media"

Swathi Vijayan.

"The relation of materinal literacy and health information comprehensibility with child health."

Sriram. R.

"Cell phone - the new fomite in hospital setting"

Dr.M.Thenral,

"Psychiatric morbidity with special reference to depression in diabetic patients"

N.B.Snehaa, III MBBS

Incidence and causes of leucorrhoea in women

Ramamanobai II year

Health education intervention study on obese children in Britania Hr. Sec. School. Pad, Chennai-50

Dr.P.C.Mythili , M.D. DVL. II nd year.

"Efficacy of Q switched Nd-Yag laser in hyper pigmentation.

Dr.B.Gayathri - M.D. Anaes.

"Levobupivacaine & Bupivacaine in spinal anaesthesia for trans urethral endoscopic surgeries" - subject to approval of the Prof. of Pharmacology.

Dr.L.Sivasankari - M.S.(ENT) P.G.

"A comparative study of results of tympanoplasty procedures with and without mastoidectomy inchronic suppurative otitis media tubotympanic disease."

Dr. Subashini. C.

"Endoscopic Assisted adenoidectomy"

Dr.S.Elangovan, - D.M. (Neurology)

"Prevalence of patent foramen ovale in patients with migraine"

Dr.M.Chinnasamy, M.D.(DVL) II year.

"Dissertation on - prospective study of "Clinico - Histopathological correlations of linear dermatoses in child hood"

Dr.K.Shivashankar, MBBS,DMRD., Tutor (for D.N.B. course)

"Role of Magnetic Resonance Cholangiopancreatography in the evaluation of biliary obstruction with particular reference to calculus obstruction"

Dr.K.Karunakaran, - M.D.(GM)

"Thyroid profile on chronic renal failure"

Dr.Amit G.Y. - M.D.(G.M)

"Spectrum of liver involvement in autoimmune diseases."

UNDERGRADUATES

1.B.Vikram, First MBBS

Effect of Music Therapy on Anxiety Reduction using Heart Rate variation analysis.

2.V.Madhav, Final part-I

Smoking patterns in people with depression, during the course of treatment

3. Sandhya Rani.C Final MBBS,

Assessment of coverage and quality of maternal and child health services at Minjur Primary Health Centre; Block level

4.C.Muralidharan, Final year.

The implications of mobile phones on hearing loss.

5.V.Sarath Chander, 3rd MBBS

Prevalence of Deafness in children.

6.B.Madhusoothanan, 3rd year

(1) Lung functions in type 2 diabetes.

(2)Hyponatremia in intensive medical care patients in GSH.

7.S.Sathyapriya – II MBBS.,

"A study about screening tests for cases of urinary tract infections (UTIs)Using Urine samples."

8.S.Moogaambiga,

"Estended spectrum beta lactamase producing microbes.

POST GRADUATES

1.Dr.R.Arunprakas –M1. P.G.

Analysis of clinical profile of systemic lupus erythematosus

2.Dr.S.Murugananth – M.2 P.G.

Clinical Profile of infectious fevers

3.Dr.N.Loganathan – M2 P.G.

Clinical and Epidemiological profile of Human Leptospirosis in North Chennai.

4.Dr. K. Babu – M3 – P.G.

Study of Clinical Profile of patients with acute inferior wall myocardial infarction.

5.Dr. S.P.Maharajan – M3 – P.G.

Analytical study of atrial fibrillation in Govt. Stanley Medical College Hospital.

6.Dr.P.R.Sowmini – M3 - P.G.

Clinical profile of arrhythmias complicating acute anterior wall myocardial infarction.

7.Dr.E.Uma Maheswari – M4 – PG

Clinical Radiological analysis of Focal seizures with CT Scan.

8.Dr.S.Sudha Selvi, M4 - PG

Clinical profile of chronic obstructive pulmonary disease.

9.Dr.N.Jayanthi. M6- PG

Prevalence of B2 glycoprotein 1 Dependent anticardiolipin antibodies in acute ischemic stroke.

10.Dr.Lavanya. S. – MD PG

Comparative study of fasting lipid profile in chronic renal failure patients on conservative management, on dialysis and after renal transplant.

11.Dr.R.Geetha – Pharmacology

Evaluation of the sedative effects produced by antihistamines inhealthy volunteers by new techniques.

12.Dr.K.G.Devibala, Pharmacology

To evaluate the efficacy of rupatadine in controlling pruritis in lichen planus.

13.Dr.B.Anitha, Physiology

Visual Evoked potentials in hypothyroid patients.

14.Dr.M.Thirumaran, Physiology

Heart rate variability analysis in alcohol dependant individuals.

15.Dr.K.Vinod, Anaesthesia

Real time ultra sound guided catheterization of IJV – A prospective comparison with land mark guided technique. (Brinkman's approach)

16.Dr.Rajesh. C.P. – M6 – PG

Cardiac conduction abnormalities and asymptomatic myocardial infarction in NIDDM patients.

The papers presented to the Committee members by the Profs./Asst. Prof./Post Graduates/Under graduates were discussed across the table while their presentation.

The above papers discussed in detail with its supportive documents submitted by them and approved the above papers submitted for Ethical Committee.

Name of the Members	Signature
Dr.A.Sundaram, Dean incharge,	
Dr.S.Madhavan, Prof. of Pharmacology,	8/10/07.
Dr.Thenmozhivalli, Prof. of Microbiology,	
Dr.S.Natarajan, Prof. of Medicine,	9.10.2007.
Dr.K.Balasubramanian, Prof. of Physiology,	
Dr.M.L.Shyamala, Prof. of Surgery,	08/10/07
Thiru M.Panneerselvam, Junior Administrative Officer.	